

## Original Article

\*These authors contributed equally to this work.

**Cite this article:** Dong M *et al* (2019). Prevalence of suicide attempt in individuals with major depressive disorder: a meta-analysis of observational surveys. *Psychological Medicine* **49**, 1691–1704. <https://doi.org/10.1017/S0033291718002301>

Received: 28 March 2018  
Revised: 25 July 2018  
Accepted: 7 August 2018  
First published online: 4 September 2018

**Key words:**

Major depressive disorder; meta-analysis; suicide attempt

**Author for correspondence:**

Yu-Tao Xiang, E-mail: [xyutly@gmail.com](mailto:xyutly@gmail.com)

# Prevalence of suicide attempt in individuals with major depressive disorder: a meta-analysis of observational surveys

Min Dong<sup>1,\*</sup>, Liang-Nan Zeng<sup>2,\*</sup>, Li Lu<sup>1,\*</sup>, Xiao-Hong Li<sup>3,\*</sup>, Gabor S. Ungvari<sup>4</sup>, Chee H. Ng<sup>5</sup>, Ines H. I. Chow<sup>1</sup>, Ling Zhang<sup>6</sup>, Yuan Zhou<sup>7</sup> and Yu-Tao Xiang<sup>1</sup>

<sup>1</sup>Unit of Psychiatry, Faculty of Health Sciences, University of Macau, Macao SAR, China; <sup>2</sup>Department of Neurosurgery, The Affiliated Hospital of Southwest Medical University, Luzhou, China; <sup>3</sup>The National Clinical Research Center for Mental Disorders, China & Center of Depression, Beijing Institute for Brain Disorders & Mood Disorders Center, Beijing Anding Hospital, Capital Medical University, Beijing, China; <sup>4</sup>University of Notre Dame Australia/Marian Centre, Perth, Australia; <sup>5</sup>Department of Psychiatry, University of Melbourne, Melbourne, Victoria, Australia; <sup>6</sup>Department of Epidemiology and Health Statistics, School of Public Health, Capital Medical University & Beijing Municipal Key Laboratory of Clinical Epidemiology, Beijing, China and <sup>7</sup>CAS Key Laboratory of Behavioral Science & Magnetic Resonance Imaging Research Center, Institute of Psychology, Chinese Academy of Sciences, Beijing, China

**Abstract**

**Background.** Suicide attempt (SA), which is one of the strongest predictors of completed suicide, is common in major depressive disorder (MDD) but its prevalence across epidemiological studies has been mixed. The aim of this comprehensive meta-analysis was to examine the pooled prevalence of SA in individuals with MDD.

**Methods.** A systematic literature search was conducted in PubMed, Embase, PsycINFO, Web of Science and Cochrane Library from their commencement date until 27 December 2017. Original studies containing data on prevalence of SA in individuals with MDD were analyzed.

**Results.** In all, 65 studies with a total of 27 340 individuals with MDD were included. Using the random effects model, the pooled lifetime prevalence of SA was 31% [95% confidence interval (CI) 27–34%], 1-year prevalence was 8% (95% CI 3–14%) and 1-month prevalence was 24% (95% CI 15–34%). Subgroup analyses revealed that the lifetime prevalence of SA was significantly associated with the patient setting, study region and income level, while the 1-month prevalence of SA was associated with only the patient setting.

**Conclusion.** This meta-analysis confirmed that SA was common in individuals with MDD across the world. Careful screening and appropriate interventions should be implemented for SA in the MDD population.

**Introduction**

Major depressive disorder (MDD) is a common psychiatric disorder associated with functional impairment and disability (Ferrari *et al.*, 2013b). The estimated point prevalence of MDD is approximately 4.7% worldwide (Ferrari *et al.*, 2013a), but the prevalence varies greatly across countries. For example, the lifetime prevalence of MDD was estimated at 3.0% in Japan, 3.3% in China and 16.9% in the USA (Andrade *et al.*, 2003; Low *et al.*, 2014).

Suicide is a major global public health challenge and accounts for 1.4% of all-cause death (WHO, 2015). Over 90% of people who died by suicide had one or more psychiatric disorders, particularly MDD that accounted for 59–87% of all suicides (Rihmer and Kiss, 2002; Cavanagh *et al.*, 2003; Nordentoft and Mortensen, 2011). Suicide attempt (SA), defined as a self-destructive act with at least some intent to end one's own life (Posner *et al.*, 2007; Kao *et al.*, 2012; Sudol and Mann, 2017), is common in MDD; for example, the risk of SA in MDD was found to be 5-fold higher than in the general population (Nock *et al.*, 2010). SA is also one of the strongest predictors of future SA or completed suicide; of people with a previous SA, 10–15% died by suicide eventually (Berman *et al.*, 2000; Oquendo *et al.*, 2004; Suominen *et al.*, 2004; Yoshimasu *et al.*, 2008).

The causes of suicide-related behaviours are complex and associated with biological, socio-cultural and clinical factors (Coentre *et al.*, 2017; Gournellis *et al.*, 2017; Sudol and Mann, 2017). Common risk factors of SA identified in depressed patients include high level of education, lower quality of life, childhood abuse, family history of psychiatric disorders, hopelessness, negative or stressful life events, psychiatric comorbidities and impulsive and aggressive behaviors (Corruble *et al.*, 1999; Dumais *et al.*, 2005; Dervic *et al.*, 2006; Dieserud *et al.*, 2010; Zayas *et al.*, 2010; Hawton *et al.*, 2013; Zhu *et al.*, 2013; Nam *et al.*, 2016; Wei *et al.*, 2017). There are also biological correlates of SA (Pawlak *et al.*, 2016; Sudol and Mann, 2017), including smaller hippocampal volume (Colle *et al.*, 2015), 5-HT<sub>2A</sub> (Gonzalez-

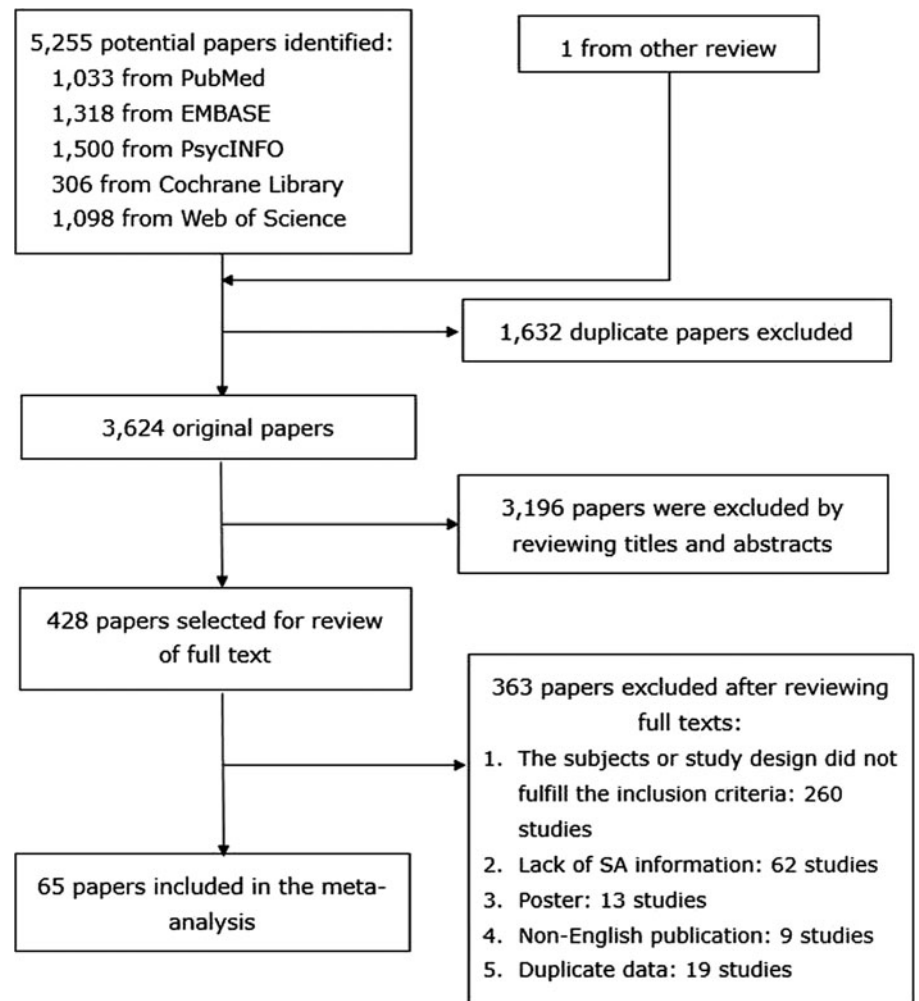


Fig. 1. Flowchart of study selection.

Castro *et al.*, 2013) and certain inflammatory processes (Arling *et al.*, 2009; Black and Miller, 2015; Courtet *et al.*, 2016).

As MDD is one of the major contributing factors of SA and most suicides occur in the first attempt (Isometsa and Lonnqvist, 1998; Shibre *et al.*, 2014), better understanding of SA patterns is critical to develop and implement effective suicide preventing strategies in patients with MDD. Although there are numerous studies of SA in MDD patients, the prevalence of SA varies greatly, and demographic and clinical contributing factors of SA in MDD are diverse. Therefore, the worldwide pattern of SA in patients with MDD and associated factors are still unclear. To date, we could not locate published meta-analysis on the prevalence of SA in adult patients with MDD.

We performed a comprehensive meta-analysis to estimate the pooled prevalence of SA in individuals with MDD and its associated factors.

## Methods

### Search strategy and selection criteria

This meta-analysis was conducted according to the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) and Meta-analysis of Observational Studies in Epidemiology (MOOSE) recommendations (Stroup *et al.*, 2000). The protocol has been registered in the International Prospective

Register of Systematic Reviews (PROSPERO) and the registration number is CRD42018086243. Two investigators (MD and LNZ) independently searched the literature in PubMed, Embase, PsycINFO, Web of Science and Cochrane Library from their commencement date until 27 December 2017. The search terms were as follows: ((attempted suicide) OR (suicide attempt) OR (suicide attempt\*)) AND (major depressi\*) AND (epidemiology OR (cross-sectional study) OR prevalence OR rate OR (cohort study) OR percentage). In the search term 'depressi\*', the asterisk is a commonly used wildcard symbol that broadens the search by finding words that start with the same letters 'depressi'. The titles and abstracts were independently screened by the two investigators, and the full texts of eligible studies were then identified. In addition, the relevant reviews were checked to identify the studies that might be missed in the first literature search. Any uncertainty about study identification was resolved by a discussion with a third investigator (XYT). The process of identifying eligible studies is shown in Fig. 1.

### Inclusion and exclusion criteria

Two investigators (MD and LNZ) independently assessed the literature for their eligibility for inclusion. The inclusion criteria according to the PICOS acronym were as follows: Participants (P): individuals with MDD by international or local diagnostic

**Table 1.** Characteristics of the studies included in the meta-analysis

No.	Principal author (year)	Reference	Country	Time of survey	Study design	Sampling method	Diagnostic criteria of MDD	Source of patients	Mean age (years)	Sample size	Proportion of males (%)	Time-frame of SA	STROBE score
1	Su (2018)	Su <i>et al.</i> (2018)	Taiwan	NA	Cross-sectional	Consecutive	DSM-IV	Outpatient	46.1	296	26.5	Lifetime	18
2	Dickerson (2017)	Dickerson <i>et al.</i> (2017)	USA	2014–2016	Cross-sectional	Consecutive	DSM-IV	Mixed	NA	48	NA	Lifetime/1 M	17
3	Nam (2016)	Nam <i>et al.</i> (2016)	Korea	NA	Cross-sectional	NA	DSM-IV	Outpatient	35.6	223	36.0	From on-set	18
4	Li (2016)	Li <i>et al.</i> (2016)	China	2007–2010	Cohort	Consecutive	DSM-IV	Outpatient	37.2	146	30.8	Lifetime	18
5	Hofer (2016)	Hofer <i>et al.</i> (2016)	Europe	2000–2004	Cohort	Consecutive	DSM-IV	Mixed	51.5	374	28.3	Lifetime	16
6	Cyprien (2016)	Cyprien <i>et al.</i> (2016)	France	NA	Cross-sectional	NA	DSM-IV	Mixed	36.5	50	0.0	Lifetime	16
7	Zeng (2015)	Zeng <i>et al.</i> (2015)	NA	NA	Cross-sectional	NA	DSM-IV	Inpatients	NA	36	NA	Lifetime	18
8	Yeh (2015)	Yeh <i>et al.</i> (2015)	Taiwan	NA	Cross-sectional	NA	DSM-IV	Inpatient	35.2	17	47.1	1 M <sup>a</sup>	17
9	Ozer (2015)	Ozer <i>et al.</i> (2015)	Turkey	NA	Cross-sectional	Consecutive	DSM-IV	Outpatient	NA	62	11.3	Lifetime	16
10	Mugisha (2015)	Mugisha <i>et al.</i> (2015)	Uganda	2013	Cross-sectional	Multistage	DSM-IV	Outpatient	NA	599	NA	Lifetime	19
11	Izci (2015)	Izci <i>et al.</i> (2015)	Turkey	NA	Cross-sectional	Random	DSM-IV	Mixed	41.4	99	59.6	Lifetime	16
12	Colle (2015)	Colle <i>et al.</i> (2015)	France	NA	Cross-sectional	NA	DSM-IV	Mixed	46.4	63	41.3	Lifetime/1 Y	18
13	Carlberg (2015)	Carlberg <i>et al.</i> (2015)	Europe	NA	Cross-sectional	NA	DSM-IV	NA	50.9	250	27.2	Lifetime	17
14	Baek (2015)	Baek <i>et al.</i> (2015)	Korea	2011–2014	Cohort	Consecutive	DSM-IV	Outpatient	48.2	300	22.3	Lifetime	18
15	Yenilmez (2014)	Yenilmez <i>et al.</i> (2014)	Turkey	2010–2011	Cross-sectional	NA	DSM-IV	NA	36.6	58	22.4	Lifetime	16
16	Tsuji (2014)	Tsuji <i>et al.</i> (2014)	Japan	NA	Cross-sectional	NA	DSM-IV	NA	42.7	161	46.6	Lifetime	16
17	Subramaniam (2014)	Subramaniam <i>et al.</i> (2014)	Singapore	2009–2010	Cross-sectional	Stratified	DSM-IV	Outpatient	NA	417	40.8	Lifetime	20
18	Shibre (2014)	Shibre <i>et al.</i> (2014)	Ethiopia	1998–2001	Cohort	Two-stage	DSM-IV/ ICD-10	Outpatient	NA	216	NA	Lifetime	19
19	Riihimaki (2014)	Riihimaki <i>et al.</i> (2014)	Finland	NA	Cohort	Stratified	DSM-IV	Outpatient	NA	137	NA	Lifetime	19
20	Peng (2014)		China	NA	Cross-sectional	NA	DSM-IV	Mixed	29.3	38	34.2	Lifetime	17

(Continued)

**Table 1.** (Continued.)

No.	Principal author (year)	Reference	Country	Time of survey	Study design	Sampling method	Diagnostic criteria of MDD	Source of patients	Mean age (years)	Sample size	Proportion of males (%)	Time-frame of SA	STROBE score
		Peng <i>et al.</i> (2014)											
21	Park (2014)	Park <i>et al.</i> (2014)	Korea	2011–2013	Cross-sectional	NA	DSM-IV	Outpatient	40.2	86	23.3	Lifetime	18
22	Jeon (2014)	Jeon <i>et al.</i> (2014)	Korea	2006–2007, 2011	Cross-sectional	Multistage, cluster, random	DSM-IV	Outpatient	45.0	825	23.3	Lifetime	20
23	Feixas (2014)	Feixas <i>et al.</i> (2014)	Spain	2008–2011	Cross-sectional	NA	DSM-IV	Outpatient	47.1	161	21.7	Lifetime	17
24	Courtett (2014)	Courtett <i>et al.</i> (2014)	France	NA	Cohort	Consecutive	DSM-IV	Outpatient	47.3	5529	36.2	Lifetime	18
25	Beier (2014)	Beier <i>et al.</i> (2014)	USA	NA	Cross-sectional	Convenience	DSM-IV	Outpatient	35.1	48	100.0	Lifetime	19
26	Baek (2014)	Baek <i>et al.</i> (2014)	Korea	2009–2012	Cross-sectional	NA	DSM-IV	Outpatient	46.3	555	27.0	Lifetime/1 M	17
27	Zhu (2013)	Zhu <i>et al.</i> (2013)	China	NA	Cross-sectional	NA	DSM-IV	Mixed	44.4	6008	0.0	Lifetime	19
28	O'Donovan (2013)	O'Donovan <i>et al.</i> (2013)	Ireland	NA	Cross-sectional	NA	DSM-IV	Inpatients	51.3	74	29.7	1 M	17
29	Kang (2013)	Kang <i>et al.</i> (2013)	Korea	2009–2012	Cohort	NA	DSM-IV	Outpatient	54.9	108	25.0	Lifetime	18
30	Hegerl (2013)	Hegerl <i>et al.</i> (2013)	German	2005–2007	Cohort	NA	ICD-10	Outpatient	NA	2620	NA	1 Y	18
31	Banwari (2013)	Banwari <i>et al.</i> (2013)	India	2007	Cross-sectional	NA	DSM-IV	Outpatient	37.7	50	58.0	Lifetime	18
32	Pompili (2012)	Pompili <i>et al.</i> (2012)	Italy	2008–2009	Cross-sectional	NA	DSM-IV	Inpatient	NA	89	NA	1 M <sup>b</sup>	16
33	Min (2012)	Min <i>et al.</i> (2012)	Korea	NA	Cross-sectional	Consecutive	DSM-IV	NA	44.6	143	26.6	Lifetime	18
34	Ekinci (2012)	Ekinci <i>et al.</i> (2012)	Turkey	2010–2011	Cross-sectional	Consecutive	DSM-IV	Outpatient	36.8	80	37.5	Lifetime	17
35	Ben-Zeev (2012)	Ben-Zeev <i>et al.</i> (2012)	USA	NA	Cross-sectional	NA	DSM-III	Inpatient	39.3	30	23.3	Lifetime	15
36	Atay (2012)	Atay <i>et al.</i> (2012)	Turkey	NA	Cross-sectional	Stratified simple random	DSM-IV	NA	NA	222	NA	Lifetime	18
37	van Noorden (2011)	van Noorden <i>et al.</i> (2011)	Netherlands	2004–2006	Cohort	NA	DSM-IV	Outpatient	39.2	1105	35.7	Lifetime	20
38	Sublette (2011)		USA	NA	Cross-sectional	NA	DSM-IV	NA	37.8	30	53.3	Lifetime	17

		Sublette <i>et al.</i> (2011)											
39	Mitchell (2011)	Mitchell <i>et al.</i> (2011)	Australia	NA	Cross-sectional	NA	DSM-IV	NA	NA	120	30.8	Lifetime	18
40	Kim (2011)	Kim <i>et al.</i> (2011)	Korea	2006–2008	Cohort	NA	DSM-IV	NA	NA	609	NA	Lifetime	18
41	Chan (2011)	Chan <i>et al.</i> (2011)	Malaysia	2007–2008	Cohort	Consecutive	DSM-IV	Inpatient	NA	42	NA	1 M	17
42	Jandl (2010)	Jandl <i>et al.</i> (2010)	German	NA	Cross-sectional	Consecutive	DSM-IV	Inpatient	48.3	50	36.0	Lifetime	16
43	Grunebaum (2010)	Grunebaum <i>et al.</i> (2010)	USA	NA	Cohort	Convenience	DSM-IV	Mixed	39.2	135	40.7	Lifetime	19
44	Wang (2009)	Wang <i>et al.</i> (2009)	China	NA	Cross-sectional	NA	DSM-IV	NA	31.6	420	46.0	1 M <sup>c</sup>	17
45	Hovanesian (2009)	Hovanesian <i>et al.</i> (2009)	NA	NA	Cross-sectional	NA	DSM-IV	Inpatient	39.0	75	37.3	Lifetime/1 M <sup>d</sup>	16
46	Fiedorowicz (2009)	Fiedorowicz <i>et al.</i> (2009)	USA	NA	Cohort	NA	DSM-IV	NA	39.9	501	41.3	Lifetime	18
47	Conrad (2009)	Conrad <i>et al.</i> (2009)	German	2004–2007	Cross-sectional	Consecutive	DSM-IV	Outpatient	36.1	394	26.4	Lifetime	17
48	Abdollahian (2009)	Abdollahian <i>et al.</i> (2009)	Iran	2006–2007	Cross-sectional	Random	DSM-IV	Inpatient	38.9	65	64.6	Lifetime	16
49	Oedegaard (2008)	Oedegaard <i>et al.</i> (2008)	Norway	NA	Cross-sectional	Consecutive	DSM-IV	Mixed	36.2	41	26.8	Lifetime	18
50	Gonzalez (2008)	Gonzalez (2008)	USA	NA	Cohort	Random, convenience	ICD-9	Outpatient	NA	162	NA	Lifetime/1 Y	16
51	Dilsaver (2008)	Dilsaver <i>et al.</i> (2008)	USA	2001–2003	Cross-sectional	Consecutive	DSM-IV	Outpatient	36.9	118	31.4	Lifetime	17
52	Sher (2006)	Sher <i>et al.</i> (2006)	NA	NA	Cross-sectional	NA	DSM-III	NA	42.3	58	48.3	Lifetime	13
53	Keilp (2006)	Keilp <i>et al.</i> (2006)	NA	1990–2003	Cross-sectional	Convenience	DSM-IV	Outpatient	37.3	275	38.5	Lifetime	19
54	Grunebaum (2005)	Grunebaum <i>et al.</i> (2005)	NA	NA	Cross-sectional	Consecutive	DSM-IV	Mixed	37.7	292	39.4	Lifetime	16
55	Corruble (2004)	Corruble <i>et al.</i> (2004)	NA	NA	Cross-sectional	Consecutive	DSM-IV	Inpatient	40.8	156	17.9	Lifetime/1 M <sup>e</sup>	15
56	McHolm (2003)	McHolm <i>et al.</i> (2003)	Canada	1990–1991	Cross-sectional	NA	DSM-III/ICD-10	Outpatient	39.2	347	0.0	Lifetime	19
57	Zlotnick (2001)	Zlotnick <i>et al.</i> (2001)	USA	NA	Cross-sectional	NA	DSM-IV	Outpatient	40.6	235	34.9	1 Y	16
58	Friedman (1999)	Friedman <i>et al.</i> (1999)	NA	NA	Cross-sectional	Random	DSM-III	Outpatient	NA	19	NA	Lifetime	16
59	Berlin (1999)	Berlin <i>et al.</i> (1999)	France	NA	Cross-sectional	NA	DSM-III	Inpatient	NA	94	29.8	Lifetime	17

(Continued)

**Table 1.** (Continued.)

No.	Principal author (year)	Reference	Country	Time of survey	Study design	Sampling method	Diagnostic criteria of MDD	Source of patients	Mean age (years)	Sample size	Proportion of males (%)	Time-frame of SA	STROBE score
60	Cleare (1997)	Cleare, (1997)	UK	NA	Cross-sectional	NA	DSM-III	NA	39.0	17	41.2	Lifetime	15
61	Spalletta (1996)	Spalletta <i>et al.</i> (1996)	Italy	NA	Cross-sectional	Consecutive	DSM-III	Outpatient	20.2	82	NA	Lifetime	16
62	Chen (1996)	Chen and Dilsaver, (1996)	USA	NA	Cross-sectional	NA	DSM-III	Outpatient	NA	801	25.8	Lifetime	15
63	Zisook (1994)	Zisook <i>et al.</i> (1994)	USA	NA	Cross-sectional	Consecutive	DSM-III	Outpatient	NA	175	NA	Lifetime	14
64	Asnis (1993)	Asnis <i>et al.</i> (1993)	NA	1987–1989	Cross-sectional	NA	DSM-III	Outpatient	NA	235	NA	Lifetime	14
65	Linkowski (1985)	Linkowski <i>et al.</i> (1985)	Belgium	1978–1984	Cross-sectional	NA	RDC	Inpatient	48.0	469	32.4	Lifetime	17

DSM, Diagnostic and Statistical Manual of Mental Disorders; ICD, International Statistical Classification of Diseases and Related Health Problems; M, month; NA, not applicable; RDC, Research Diagnostic Criteria; SA, suicide attempt; Y, years.

<sup>a</sup>2 weeks.  
<sup>b</sup>24–48 h.  
<sup>c</sup>1 week.  
<sup>d</sup>24 h.  
<sup>e</sup>6 days.

criteria, such as the Diagnostic and Statistical Manual of Mental Disorders (DSM), the International Statistical Classification of Diseases and Related Health Problems (ICD) systems or China’s mental disorder classification and diagnosis standard (CCMD) diagnostic system (Chen, 2002). Intervention (I): not applicable; Comparison (C): not applicable; Outcomes (O): not applicable and Study design (S): cross-sectional or cohort studies (only the baseline data were extracted) reporting prevalence of SA or relevant data that could generate prevalence of SA. The timeframe of prevalence was reported, such as lifetime, 1 year, 1 month or from the onset of MDD. Exclusion criteria included: (1) studies conducted in special populations, such as adolescent or the elderly and (2) data extracted from medical records. Several studies on major depressive episode (MDE) included individuals with dysthymia, such as Seo *et al.*, 2014 and Park *et al.*, 2017 or bipolar depressive episode, such as Serafini *et al.*, 2011 and Wakefield and Schmitz, 2016, therefore these studies were excluded with the exception of those which included only individuals with MDD (following confirmation by the corresponding authors). If more than one paper based on the same dataset were published, only the paper with the largest sample was included.

**Data extraction and quality assessment**

The data extraction was independently conducted by two investigators (MD and LNZ). The following information was extracted from each study using a standardized data collection form: the first author, year of publication and survey, study location, study design, sampling method, patient setting (inpatients, outpatients or mixed), diagnostic criteria of MDD, sample size, proportion of males, mean age, number of individuals with SA, assessment of SA and timeframe.

The quality of included studies was assessed with the 22-item Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) (Von Elm *et al.*, 2007). Studies with a total score >11 were considered as ‘good quality’ (Cao *et al.*, 2015).

**Statistical analysis**

The data analyses were conducted with STATA version 12.0 (Stata Corporation, College Station, Texas, USA) and Comprehensive Meta-Analysis (CMA) Version 2.0 (Biostat Inc., Englewood, New Jersey, USA). The pooled prevalence and its 95% confidence interval (95% CI) was calculated with the random effects model. Heterogeneity across studies was assessed with  $I^2$  statistic;  $I^2 > 50\%$  was defined as high heterogeneity (Higgins *et al.*, 2003). Subgroup analyses, meta-regression and sensitivity analyses were performed to explore the possible sources of heterogeneity. Subgroup analyses were performed according to the following variables: year of survey and sample size (using the median splitting method), patient setting, income level classified by the World Bank (low/middle/high) (Worldbank, 2017), broad WHO regional classification (Africa/Americas/Eastern Mediterranean/Europe/South East Asia/Western Pacific) (Chen *et al.*, 2018) and study design. Meta-regression analyses were performed in lifetime prevalence of SA based on sample size and percentage of males. Publication bias was estimated with funnel plots and Begg’s test (Begg and Mazumdar, 1994). The statistical significance was considered as  $p < 0.05$  (two sided).



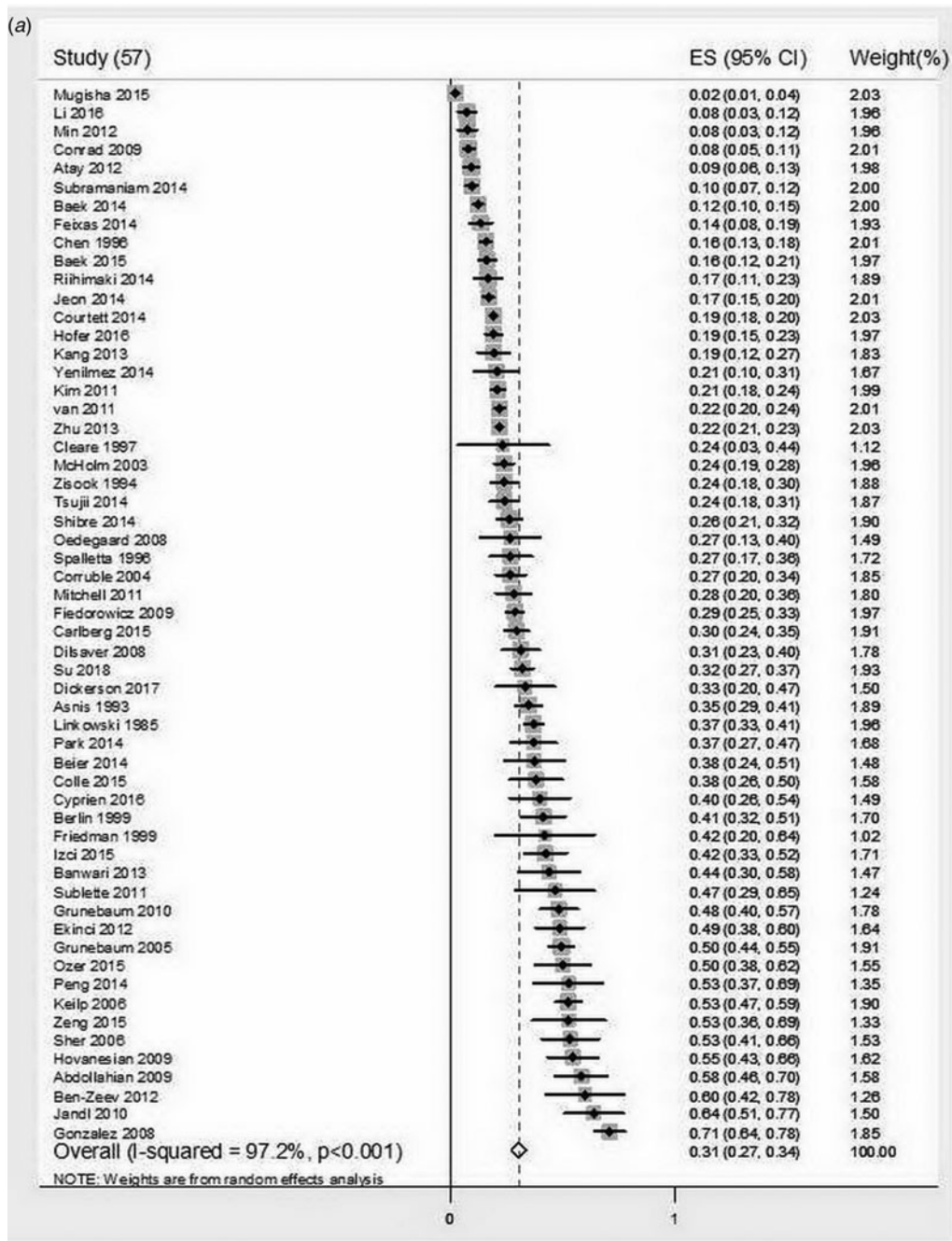


Fig. 2. Forest plot of prevalence of SA. (a) Lifetime prevalence of SA. (b). 1-year prevalence of SA. (c) 1-month prevalence of SA.

**Results**

*Search results and study characteristics*

Table 1 shows the characteristics of the included studies. Altogether 5255 articles were retrieved and finally 65 studies with 27 340 individuals that fulfilled the study criteria were included in the meta-analysis. The sample size ranged from 17 to 6008 individuals. The mean age ranged from 20.2 to 54.9 years. Of the 65 studies, 57 studies with 23 620 individuals reported the lifetime prevalence of SA, five studies with 3099 individuals reported 1-year prevalence of SA, nine studies with 1476 individuals reported 1-month prevalence of SA and one study reported prevalence of SA from the onset of MDD. Of the

included studies, there were 51 cross-sectional studies and 14 cohort studies. The majority of studies ( $n = 60$ ) used the DSM system, two studies used ICD, two studies used DSM or/and ICD and one study used the Research Diagnostic Criteria (RDC) (Spitzer *et al.*, 1978). The quality assessment score ranges from 13 to 20, and all were considered high quality.

*Overall prevalence of SA*

The pooled lifetime prevalence of SA was 31% (95% CI 27–34%;  $I^2 = 97.2%$ ) (Fig. 2a), 1-year prevalence was 8% (95% CI 3–14%;  $I^2 = 92.4%$ ) (Fig. 2b) and 1-month prevalence was 24% (95% CI

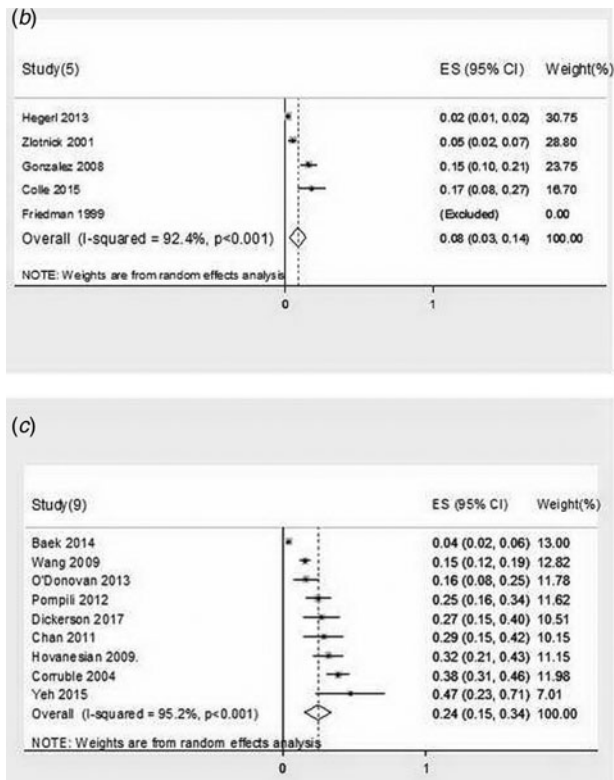


Fig. 2. (Continued.)

15–34%;  $I^2 = 95.2%$ ) (Fig. 2c). The prevalence of SA since the onset of MDD was 39.5% (Nam *et al.*, 2016).

### Sensitivity analysis and publication bias

The sensitivity analysis of lifetime prevalence of SA showed that after removing each study sequentially, the pooled prevalence did not change significantly. The funnel plot showed slight asymmetry by visual inspection (Fig. 3), but did not reach significant level in the Begg's test ( $z = 1.07$ ,  $p = 0.28$ ) which indicated that there was no publication bias in lifetime prevalence of SA.

### Subgroup analyses and meta-regression

Table 2 shows the results of subgroup analyses. Inpatient, middle/high-income countries and geographic regions of Eastern Mediterranean, South-East Asia and Americas were significantly associated with higher lifetime prevalence of SA. In the meta-regression analyses, smaller sample size ( $B = -0.00007$ ,  $z = -11.77$ ,  $p < 0.001$ ) was negatively associated, while proportion of males was positively associated with higher lifetime prevalence of SA ( $B = 0.006$ ,  $z = 6.56$ ,  $p < 0.001$ ).

Sample size was significantly associated with 1-year prevalence of SA while patient setting was significantly associated with 1-month prevalence of SA.

### Discussion

The results showed that the pooled lifetime prevalence of SA (31%) was higher than the 1-year (8%) and 1-month (24%) prevalence of SA. The 1-year prevalence of SA is lower than the 1-month prevalence probably due to the limited number of

studies reporting 1-year prevalence; therefore the result is unstable. The lifetime prevalence of SA is substantially higher than the epidemiological surveys in general populations in China (0.8%) (Cao *et al.*, 2015), USA (4.6%) (Kessler *et al.*, 1999) and Europe (1.3%) (Bernal *et al.*, 2007).

The lifetime and 1-month prevalence of SA in inpatient settings were significantly higher than in other settings. This is not surprising given that inpatients suffering from MDD usually present with more severe depressive symptoms and psychotic symptoms, which are closely associated with SA (Witte *et al.*, 2009; Holma *et al.*, 2010). Further, the risk of SA in patients during current MDD episode was found to be 7.5 times higher than in patients who had fully remitted (Sokero *et al.*, 2005). Also, psychotic features are associated with a two-fold higher risk of SA during the current depressive episode (Coryell *et al.*, 1984; Maj *et al.*, 2007; Gournellis *et al.*, 2017). Moreover, inpatients usually need hospitalization due to insufficient treatment response, which could further increase the suicide risk in MDD (Souery *et al.*, 2007).

The meta-analysis found that socioeconomic factors were significantly associated with the risk of SA; individuals with MDD in middle- and high-income countries had a higher rate of SA than in low-income countries. However, a WHO report indicated that suicidal behaviors are more likely to occur in low and middle income countries (WHO, 2015), and low income and high unemployment were risk factors of SA (Beautrais, 2000). The lack of consistency could be related to the possibility that psychiatric disorders may play a less important role in suicidal behaviors in low- and middle-income countries compared to high-income countries (Phillips *et al.*, 2002; Vijayakumar, 2004). In addition, only two studies were conducted in low-income countries, which could affect the reliability of the results. The critical lack of research in SA in MDD patients in low-income countries needs to be urgently addressed.

The relative high lifetime prevalence of SA in Eastern Mediterranean (58.5%) and South-East Asia (44.0%) could be due to the small number of studies, i.e. only one study was done in each region respectively. The lifetime rate of SA in Americas (36.3%) and Europe (27.5%) was higher than the Western Pacific (19.8%) and Africa (9.2%) regions. This appears consistent with the different prevalence of MDD across countries, for example, the prevalence of MDD in the USA (16.9%) was much higher than in China (3.3%) (Andrade *et al.*, 2003; Low *et al.*, 2014). It is likely that the discrepancy in health resources and economic and sociocultural factors may contribute to the different SA rates across regions (Cao *et al.*, 2017).

Similar to other meta-analysis (Cao *et al.*, 2017), meta-regression and subgroup analyses revealed that higher lifetime and 1-year prevalence of SA was associated with studies with small sample size, the results of which are relatively more unstable. Male gender was positively associated with lifetime prevalence of SA, which is consistent with previous findings. For example, most deaths in MDD due to suicide occurred in men (Henriksson *et al.*, 1993; Blair-West *et al.*, 1999) and male gender is a major risk factor of suicide in both depressed patients (Hawton *et al.*, 2013) and general populations (Nock *et al.*, 2008; Cao *et al.*, 2015). More severe stigma (Griffiths *et al.*, 2008), higher levels of aggression and impulsivity (Dumais *et al.*, 2005) and higher unemployment rate in men (Osváth *et al.*, 2003) are also associated with increased risk of suicidal behaviors.

As one of the strongest predictors of suicide (Harris and Barraclough, 1997), SA is shown to be associated with male



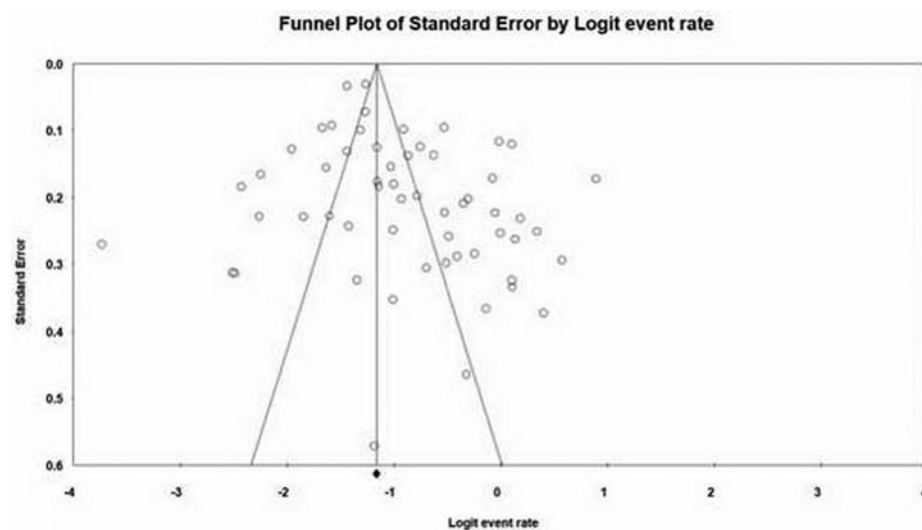


Fig. 3. Funnel plot of publication bias for lifetime prevalence of SA.

Table 2. Subgroup analyses of prevalence of SA

Subgroup	Categories (no. of studies)	Patients with SA	Total patients with MDD	Prevalence (%)	95% CI (%)	<i>I</i> <sup>2</sup> (%)	<i>p</i> values within subgroup <sup>a</sup>	<i>p</i> values across subgroups <sup>b</sup>
Lifetime prevalence of SA								
	Total (57)	5339	23 620	<b>31.0</b>	27.0–34.0	97.2	<0.001	
Year of survey	Before October 2006 (12)	1233	5032	<b>27.3</b>	20.3–35.6	96.0	<0.001	3.539 (0.06)
	After October 2006 (12)	347	2606	<b>18.0</b>	12.8–24.7	94.4	<0.001	
Source of patients	Inpatient (8)	403	975	<b>48.5</b>	36.9–60.2	84.4	0.8	18.378 ( <b>&lt;0.001</b> )
	Outpatient (28)	2682	13 328	<b>23.8</b>	19.6–28.6	96.0	<0.001	
	Mixed (10)	1741	7148	<b>36.2</b>	27.1–46.4	95.4	0.009	
Income	High (42)	3519	15 278	<b>29.3</b>	25.1–33.9	95.4	<0.001	8.473 ( <b>0.014</b> )
	Middle (10)	1562	6828	<b>32.1</b>	23.2–42.4	94.8	0.001	
	Low (2)	71	815	<b>9.0</b>	3.6–20.8	98.6	<0.001	
Region	Africa (2)	71	815	<b>9.2</b>	4.2–19.1	98.6	<0.001	26.86 ( <b>&lt;0.001</b> )
	Americas (11)	679	2395	<b>36.3</b>	28.4–45.0	95.4	0.002	
	Eastern Mediterranean (1)	38	65	<b>58.5</b>	29.4–82.6	0	0.582	
	Europe (20)	1999	9337	<b>27.5</b>	22.4–33.2	93.9	<0.001	
	South-East Asia (1)	22	50	<b>44.0</b>	18.4–73.2	0	0.704	
	Western Pacific (14)	2017	9812	<b>19.8</b>	15.2–25.3	91.6	<0.001	
Study design	Cross-sectional (45)	3348	14 298	<b>30.2</b>	26.2–34.5	95.1	<0.001	1.868 (0.172)
	Cohort (12)	1991	9322	<b>24.5</b>	18.3–31.8	95.9	<0.001	
1 year prevalence of SA								
	Total (5)	87	3099	<b>8.0</b>	3.0–14.0	92.4	<0.001	
Source of patients	Outpatient (4)	76	3036	<b>4.5</b>	1.1–17.0	96.4	<0.001	0.872 (0.35)
	Mixed (1)	11	63	<b>17.5</b>	1.3–77.8	0	0.278	
Sample size	>162 (2)	11	63	<b>2.6</b>	1.1–6.9	90.9	<0.001	8.835 ( <b>0.003</b> )
	≤162 (3)	36	244	<b>14.3</b>	6.6–28.1	3.4	<0.001	

(Continued)

**Table 2.** (Continued.)

Subgroup	Categories (no. of studies)	Patients with SA	Total patients with MDD	Prevalence (%)	95% CI (%)	$I^2$ (%)	$p$ values within subgroup <sup>a</sup>	$p$ values across subgroups <sup>b</sup>
Region	Americas (3)	36	416	<b>6.8</b>	1.2–30.6	84.8	0.004	0.037 (0.847)
	Europe (2)	51	2683	<b>5.3</b>	0.7–29.6	98.0	0.005	
Study design	Cross-sectional (3)	22	317	<b>7.0</b>	1.1–34.4	82.1	0.009	0.056 (0.841)
	Cohort (2)	65	2782	<b>5.0</b>	0.6–31.7	98.8	0.008	
1 month prevalence of SA								
	Total (9)	238	1476	<b>24.0</b>	15.0–34.0	95.2	<0.001	
Year of survey	Before October 2008 (2)	34	131	<b>26.6</b>	6.9–63.9	0	0.209	0.922 (0.337)
	After October 2008 (2)	35	603	<b>10.8</b>	2.4–36.9	96.8	0.009	
Source of patients	Inpatient (6)	138	453	<b>29.8</b>	22.5–38.3	66.4	<0.001	24.244 (< <b>0.001</b> )
	Outpatient (1)	22	555	<b>4.0</b>	1.7–8.8	0	<0.001	
	Mixed (1)	13	48	<b>27.1</b>	12.3–49.6	0	0.046	
Sample size	>75 (4)	169	1220	<b>16.6</b>	7.4–33.1	97.1	0.001	1.245 (0.265)
	≤75 (5)	69	256	<b>28.8</b>	14.7–48.7	52.3	0.038	
Income	High (6)	137	939	<b>21.8</b>	10.1–40.9	95.4	0.006	0.002 (0.961)
	Middle (2)	77	462	<b>21.0</b>	5.3–55.9	77.9	0.096	
Region	Americas (1)	13	48	<b>27.1</b>	4.8–73.1	0	0.329	0.249 (0.883)
	Europe (2)	34	163	<b>20.2</b>	5.9–50.4	42.7	0.053	
	Western Pacific (4)	107	1034	<b>17.5</b>	7.3–36.4	94.9	0.002	

SA, suicide attempt.

Bolded values:  $p < 0.05$ .<sup>a</sup>Test of heterogeneity within subgroups.<sup>b</sup>Test of prevalence of SA across subgroups.

gender, acute disorders occurring in the week preceding death and inadequate pharmacotherapy in patients with severe psychiatric disorders including MDD (Shibre *et al.*, 2014). The association between male gender and SA was confirmed in the meta-regression analyses. The possible reason could be that male patients with MDD were more likely to present with impulsive and aggressive behaviors and have alcohol abuse, all of which could increase the risk of suicide-related behaviors including SA (Dumais *et al.*, 2005).

The strengths of this meta-analysis include the large number of studies across many countries and the large sample size. However, several methodological limitations need to be noted. First, publication bias was not assessed for 1-year and 1-month prevalence of SA since the number of eligible studies with available data were <10 (Wan *et al.*, 2013). Second, certain variables related to SA were unavailable, such as medical and psychiatric comorbidities, treatment sought from professionals for MDD, treatment type, urban or rural residence, illness severity and psychiatric comorbidities (Vickers and McNally, 2004; Dumais *et al.*, 2005; Sher, 2006; Nepon *et al.*, 2010; Hawton *et al.*, 2013). Third, heterogeneity could not be avoided in the meta-analysis of epidemiological studies (Winsper *et al.*, 2013; Long *et al.*, 2014) although subgroup analyses have been conducted. The heterogeneity could be attributed to different socioeconomic contexts, sampling methods, depression severity and antidepressant treatments. Fourth, the possibility of recall bias in SA could not be excluded.

This meta-analysis confirmed that SA was very common in individuals with MDD worldwide, especially among inpatient populations and those living in high-income countries. It is critical to develop and implement effective screening and appropriate interventions for SA in the MDD population.

**Acknowledgements.** This study was supported by the University of Macau (MYRG2015-00230-FHS and MYRG2016-00005-FHS), the National Key Research & Development Program of China (no. 2016YFC1307200), the Beijing Municipal Administration of Hospitals Clinical Medicine Development of Special Funding Support (no. ZYLX201607) and Beijing Municipal Administration of Hospitals' Ascent Plan (no. DFL20151801).

**Conflict of interest.** None.

## References

- Abdollahian E, Gharavi MM, Soltanifar A and Mokhber N (2009) Relationship between positive and negative symptoms of schizophrenia and psychotic depression with risk of suicide. *Iranian Journal of Psychiatry and Behavioral Sciences* 3, 27–32.
- Andrade L, Caraveo-anduaga JJ, Berglund P, Bijl RV, Graaf RD, Vollebergh W, Dragomirecka E, Kohn R, Keller M and Kessler RC (2003) The epidemiology of major depressive episodes: results from the International Consortium of Psychiatric Epidemiology (ICPE) Surveys. *International Journal of Methods in Psychiatric Research* 12, 3–21.
- Arling TA, Yolken RH, Lapidus M, Langenberg P, Dickerson FB, Zimmerman SA, Balis T, Cabassa JA, Scrandis DA and Tonelli LH

- (2009) *Toxoplasma gondii* antibody titers and history of suicide attempts in patients with recurrent mood disorders. *Journal of Nervous and Mental Disease* **197**, 905–908.
- Asnis GM, Friedman TA, Sanderson WC, Kaplan ML, Van Praag HM and Harkavy-Friedman JM** (1993) Suicidal behaviors in adult psychiatric outpatients, 1. Description and Prevalence. *American Journal of Psychiatry* **150**, 108–112.
- Atay IM, Eren I and Gundogar D** (2012) The prevalence of death ideation and attempted suicide and the associated risk factors in Isparta, Turkey. *Turk Psikiyatri Dergisi* **23**, 89–98.
- Baek JH, Kang ES, Fava M, Mischoulon D, Nierenberg AA, Yu BH, Lee D and Jeon HJ** (2014) Serum lipids, recent suicide attempt and recent suicide status in patients with major depressive disorder. *Progress in Neuro-Psychopharmacology and Biological Psychiatry* **51**, 113–118.
- Baek JH, Heo JY, Fava M, Mischoulon D, Nierenberg A, Hong JP, Roh S and Jeon HJ** (2015) Anxiety symptoms are linked to new-onset suicidal ideation after six months of follow-up in outpatients with major depressive disorder. *Journal of Affective Disorders* **187**, 183–187.
- Banwari GH, Vankar GK and Parikh MN** (2013) Comparison of suicide attempts in schizophrenia and major depressive disorder: an exploratory study. *Asia and Pacific Psychiatry* **5**, 309–315.
- Beautrais AL** (2000) Risk factors for suicide and attempted suicide among young people. *Australian and New Zealand Journal of Psychiatry* **34**, 420–436.
- Begg CB and Mazumdar M** (1994) Operating characteristics of a rank correlation test for publication bias. *Biometrics* **50**, 1088–1101.
- Beier AM, Lauritzen L, Galfalvy HC, Cooper TB, Oquendo MA, Grunebaum MF, Mann JJ and Sublette ME** (2014) Low plasma eicosapentaenoic acid levels are associated with elevated trait aggression and impulsivity in major depressive disorder with a history of comorbid substance use disorder. *Journal of Psychiatric Research* **57**, 133–140.
- Ben-Zeev D, Young MA and Depp CA** (2012) Real-time predictors of suicidal ideation: mobile assessment of hospitalized depressed patients. *Psychiatry Research* **197**, 55–59.
- Berlin I, Payan C, Corruble E and Puech AJ** (1999) Serum thyroid-stimulating-hormone concentration as an index of severity of major depression. *International Journal of Neuropsychopharmacology* **2**, 105–110.
- Berman AL, Silverman MM and Bongar BM** (2000) *Comprehensive Textbook of Suicidology*. New York: Guilford Press.
- Bernal M, Haro JM, Bernert S, Brugha T, de Graaf R, Bruffaerts R, Lepine JP, de Girolamo G, Vilagut G, Gasquet I, Torres JV, Kovess V, Heider D, Neeleman J, Kessler R and Alonso J** (2007) Risk factors for suicidality in Europe: results from the ESEMED study. *Journal of Affective Disorders* **101**, 27–34.
- Black C and Miller BJ** (2015) Meta-analysis of cytokines and chemokines in suicidality: distinguishing suicidal versus nonsuicidal patients. *Biological Psychiatry* **78**, 28–37.
- Blair-West GW, Cantor CH, Mellsop GW and Eysen-Annan ML** (1999) Lifetime suicide risk in major depression: sex and age determinants. *Journal of Affective Disorders* **55**, 171–178.
- Cao X-L, Zhong B-L, Xiang Y-T, Ungvari GS, Lai KY, Chiu HF and Caine ED** (2015) Prevalence of suicidal ideation and suicide attempts in the general population of China: a meta-analysis. *International Journal of Psychiatry in Medicine* **49**, 296–308.
- Cao XL, Wang SB, Zhong BL, Zhang L, Ungvari GS, Ng CH, Li L, Chiu HFK, Lok GKI, Lu JP, Jia FJ and Xiang YT** (2017) The prevalence of insomnia in the general population in China: a meta-analysis. *PLoS One* **12**, e0170772.
- Carlberg L, Schosser A, Calati R, Serretti A, Massat I, Papageorgiou K, Kocabas NA, Mendlewicz J, Zohar J, Montgomery SA, Souery D and Kasper S** (2015) Association study of CREB1 polymorphisms and suicidality in MDD: results from a European multicenter study on treatment resistant depression. *International Journal of Neuroscience* **125**, 336–343.
- Cavanagh JT, Carson AJ, Sharpe M and Lawrie SM** (2003) Psychological autopsy studies of suicide: a systematic review. *Psychological Medicine* **33**, 395–405.
- Chan LF, Maniam T and Shamsul AS** (2011) Suicide attempts among depressed inpatients with depressive disorder in a Malaysian sample: psychosocial and clinical risk factors. *Crisis: Journal of Crisis Intervention and Suicide Prevention* **32**, 283–287.
- Chen YF** (2002) Chinese classification of mental disorders (CCMD-3): towards integration in international classification. *Psychopathology* **35**, 171–175.
- Chen YW and Dilsaver SC** (1996) Lifetime rates of suicide attempts among subjects with bipolar and unipolar disorders relative to subjects with other Axis I disorders. *Biological Psychiatry* **39**, 896–899.
- Chen S-J, Shi L, Bao Y-P, Sun Y-K, Lin X, Que J-Y, Vitiello MV, Zhou Y-X, Wang Y-Q and Lu L** (2018) Prevalence of restless legs syndrome during pregnancy: a systematic review and meta-analysis. *Sleep Medicine Reviews* **40**, 43–54.
- Cleare AJ** (1997) Reduced whole blood serotonin in major depression. *Depression and Anxiety* **5**, 108–111.
- Coentre R, Talina MC, Góis C and Figueira ML** (2017) Depressive symptoms and suicidal behavior after first-episode psychosis: a comprehensive systematic review. *Psychiatry Research* **253**, 240–248.
- Colle R, Chupin M, Cury C, Vandendrie C, Gressier F, Hardy P, Falissard B, Colliot O, Ducreux D & Corruble E** (2015) Depressed suicide attempters have smaller hippocampus than depressed patients without suicide attempts. *Journal of Psychiatric Research* **61**, 13–18.
- Conrad R, Walz F, Geiser F, Imbierowicz K, Liedtke R and Wegener I** (2009) Temperament and character personality profile in relation to suicidal ideation and suicide attempts in major depressed patients. *Psychiatry Research* **170**, 212–217.
- Corruble E, Damy C and Guelfi J** (1999) Impulsivity: a relevant dimension in depression regarding suicide attempts? *Journal of Affective Disorders* **53**, 211–215.
- Corruble E, Bronnec M, Falissard B and Hardy P** (2004) Defense styles in depressed suicide attempters. *Psychiatry and Clinical Neurosciences* **58**, 285–288.
- Coryell W, Pfohl B and Zimmerman M** (1984) The clinical and neuroendocrine features of psychotic depression. *Journal of Nervous and Mental Disease* **172**, 521–528.
- Courtet P, Giner L, Seneque M, Guillaume S, Olie E and Ducasse D** (2016) Neuroinflammation in suicide: toward a comprehensive model. *World Journal of Biological Psychiatry* **17**, 564–586.
- Courtet P, Jaussent I, Lopez-Castroman J and Gorwood P** (2014) Poor response to antidepressants predicts new suicidal ideas and behavior in depressed outpatients. *European Neuropsychopharmacology* **24**, 1650–1658.
- Cyprien F, de Champfleury NM, Deverduin J, Olie E, Le Bars E, Bonafe A, Mura T, Jollant F, Courtet P and Artero S** (2016) Corpus callosum integrity is affected by mood disorders and also by the suicide attempt history: a diffusion tensor imaging study. *Journal of Affective Disorders* **206**, 115–124.
- Dervic K, Grunebaum MF, Burke AK, Mann JJ and Oquendo MA** (2006) Protective factors against suicidal behavior in depressed adults reporting childhood abuse. *Journal of Nervous and Mental Disease* **194**, 971–974.
- Dickerson F, Adamos M, Katsafanas E, Khushalani S, Origoni A, Savage C, Schweinfurth L, Stallings C, Sweeney K, Alaadini A, Uhde M, Severance E, Wilcox HC and Yolken R** (2017) The association between immune markers and recent suicide attempts in patients with serious mental illness: a pilot study. *Psychiatry Research* **255**, 8–12.
- Dieserud G, Gerhardsen RM, Van den Weghe H and Corbett K** (2010) Adolescent suicide attempts in Baerum, Norway, 1984–2006. *Crisis* **31**, 255–264.
- Dilsaver SC, Benazzi F, Akiskal KK and Akiskal HS** (2008) Differential patterns of lifetime multiple anxiety disorder comorbidity between Latino adults with bipolar I and major depressive disorders. *Bulletin of the Menninger Clinic* **72**, 130–148.
- Dumais A, Lesage AD, Alda M, Rouleau G, Dumont M, Chawky N, Roy M, Mann JJ, Benkelfat C and Turecki G** (2005) Risk factors for suicide completion in major depression: a case-control study of impulsive and aggressive behaviors in men. *American Journal of Psychiatry* **162**, 2116–2124.
- Ekinci O, Albayrak Y and Ekinci AE** (2012) Temperament and character in euthymic major depressive disorder patients: the effect of previous suicide attempts and psychotic mood episodes. *Psychiatry Investigation* **9**, 119–126.

- Feixas G, Montesano A, Compan V, Salla M, Dada G, Pucurull O, Trujillo A, Paz C, Munoz D, Gasol M, Saul LA, Lana F, Bros I, Ribeiro E, Winter D, Carrera-Fernandez MJ and Guardia J (2014) Cognitive conflicts in major depression: between desired change and personal coherence. *British Journal of Clinical Psychology* 53, 369–385.
- Ferrari A, Somerville A, Baxter A, Norman R, Patten S, Vos T and Whiteford H (2013a) Global variation in the prevalence and incidence of major depressive disorder: a systematic review of the epidemiological literature. *Psychological Medicine* 43, 471–481.
- Ferrari AJ, Charlson FJ, Norman RE, Patten SB, Freedman G, Murray CJ, Vos T and Whiteford HA (2013b) Burden of depressive disorders by country, sex, age, and year: findings from the global burden of disease study 2010. *PLoS Medicine* 10, e1001547.
- Fiedorowicz JG, Leon AC, Keller MB, Solomon DA, Rice JP and Coryell WH (2009) Do risk factors for suicidal behavior differ by affective disorder polarity? *Psychological Medicine* 39, 763–771.
- Friedman S, Smith L and Fogel D (1999) Suicidality in panic disorder: a comparison with schizophrenic, depressed, and other anxiety disorder outpatients. *Journal of Anxiety Disorders* 13, 447–461.
- Gonzalez VM (2008) Recognition of mental illness and suicidality among individuals with serious mental illness. *Journal of Nervous and Mental Disease* 196, 727–734.
- Gonzalez-Castro TB, Tovilla-Zarate C, Juarez-Rojop I, Pool Garcia S, Velazquez-Sanchez MP, Genis A, Nicolini H and Lopez Narvaez L (2013) Association of the 5HT2A gene with suicidal behavior: case-control study and updated meta-analysis. *BioMed Central Psychiatry* 13, 25.
- Gournellis R, Tournikioti K, Touloumi G, Thomadakis C, Michalopoulou PG, Christodoulou C, Papadopoulou A and Douzenis A (2017) Psychotic (delusional) depression and suicidal attempts: a systematic review and meta-analysis. *Acta Psychiatrica Scandinavica* 137, 18–29.
- Griffiths KM, Christensen H and Jorm AF (2008) Predictors of depression stigma. *BioMed Central Psychiatry* 8, 25.
- Grunebaum MF, Keilp J, Li SH, Ellis SP, Burke AK, Oquendo MA and Mann JJ (2005) Symptom components of standard depression scales and past suicidal behavior. *Journal of Affective Disorders* 87, 73–82.
- Grunebaum MF, Galfalvy HC, Mortenson LY, Burke AK, Oquendo MA and Mann JJ (2010) Attachment and social adjustment: relationships to suicide attempt and major depressive episode in a prospective study. *Journal of Affective Disorders* 123, 123–130.
- Harris EC and Barraclough B (1997) Suicide as an outcome for mental disorders. A meta-analysis. *British Journal of Psychiatry* 170, 205–228.
- Hawton K, Comabella CCI, Haw C and Saunders K (2013) Risk factors for suicide in individuals with depression: a systematic review. *Journal of Affective Disorders* 147, 17–28.
- Hegerl U, Mergl R, Quail D, Schneider E, Strauss M, Hundemer HP and Linden M (2013) Fast versus slow onset of depressive episodes: a clinical criterion for subtyping patients with major depression. *European Psychiatry* 28, 288–292.
- Henriksson MM, Aro HM, Marttunen MJ, Heikkinen ME, Isometsa E, Kuoppasalmi KI and Lonnqvist J (1993) Mental disorders and comorbidity in suicide. *American Journal of Psychiatry* 150, 935–935.
- Higgins JP, Thompson SG, Deeks JJ and Altman DG (2003) Measuring inconsistency in meta-analyses. *British Medical Journal* 327, 557.
- Hofer P, Schosser A, Calati R, Serretti A, Massat I, Kocabas NA, Konstantinidis A, Mendlewicz J, Souery D, Zohar J, Juven-Wetzler A, Montgomery S and Kasper S (2016) The impact of serotonin receptor 1A and 2A gene polymorphisms and interactions on suicide attempt and suicide risk in depressed patients with insufficient response to treatment – a European multicentre study. *International Clinical Psychopharmacology* 31, 1–7.
- Holma KM, Melartin TK, Haukka J, Holma IA, Sokero TP and Isometsa ET (2010) Incidence and predictors of suicide attempts in DSM-IV major depressive disorder: a five-year prospective study. *American Journal of Psychiatry* 167, 801–808.
- Hovanessian S, Isakov I and Cervellione KL (2009) Defense mechanisms and suicide risk in major depression. *Archives of Suicide Research* 13, 74–86.
- Isometsa ET and Lonnqvist JK (1998) Suicide attempts preceding completed suicide. *British Journal of Psychiatry* 173, 531–535.
- Izci F, Zincir S, Zincir SB, Bilici R, Gica S, Koc MSI, Goncu T, Terzi A and Semiz UB (2015) Suicide attempt, suicidal ideation and hopelessness levels in major depressive patients with and without alexithymia. *Dusunen Adam* 28, 27–33.
- Jandl M, Steyer J and Kaschka WP (2010) Suicide risk markers in major depressive disorder: a study of electrodermal activity and event-related potentials. *Journal of Affective Disorders* 123, 138–149.
- Jeon HJ, Park JI, Fava M, Mischoulon D, Sohn JH, Seong S, Park JE, Yoo I and Cho MJ (2014) Feelings of worthlessness, traumatic experience, and their comorbidity in relation to lifetime suicide attempt in community adults with major depressive disorder. *Journal of Affective Disorders* 166, 206–212.
- Kang HJ, Kim JM, Lee JY, Kim SY, Bae KY, Kim SW, Shin IS, Kim HR, Shin MG and Yoon JS (2013) BDNF promoter methylation and suicidal behavior in depressive patients. *Journal of Affective Disorders* 151, 679–685.
- Kao Y-C, Liu Y-P, Cheng T-H and Chou M-K (2012) Subjective quality of life and suicidal behavior among Taiwanese schizophrenia patients. *Social Psychiatry and Psychiatric Epidemiology* 47, 523–532.
- Keilp JG, Gorlyn M, Oquendo MA, Brodsky B, Ellis SP, Stanley B and John Mann J (2006) Aggressiveness, not impulsiveness or hostility, distinguishes suicide attempters with major depression. *Psychological Medicine* 36, 1779–1788.
- Kessler RC, Borges G and Walters EE (1999) Prevalence of and risk factors for lifetime suicide attempts in the National Comorbidity Survey. *Archives of General Psychiatry* 56, 617–626.
- Kim S-W, Stewart R, Kim J-M, Shin II S, Yoon J-S, Jung S-W, Lee M-S, Yim H-W and Jun T-Y (2011) Relationship between a history of a suicide attempt and treatment outcomes in patients with depression. *Journal of Clinical Psychopharmacology* 31, 449–456.
- Li K, Wei Q, Li G, He X, Liao Y and Gan Z (2016) Time to lack of persistence with pharmacological treatment among patients with current depressive episodes: a natural study with 1-year follow-up. *Patient Preference and Adherence* 10, 2209–2215.
- Linkowski P, de Maertelaer V and Mendlewicz J (1985) Suicidal behaviour in major depressive illness. *Acta Psychiatrica Scandinavica* 72, 233–238.
- Long J, Huang G, Liang W, Liang B, Chen Q, Xie J, Jiang J and Su L (2014) The prevalence of schizophrenia in mainland China: evidence from epidemiological surveys. *Acta Psychiatrica Scandinavica* 130, 244–256.
- Low W, Azmi S, Li Y, Yee SL, Abdat A, Kalita P, Ge L and Milea D (2014) Prevalence of major depressive disorder in China. *Value in Health* 17, A767.
- Maj M, Pirozzi R, Magliano L, Fiorillo A and Bartoli L (2007) Phenomenology and prognostic significance of delusions in major depressive disorder: a 10-year prospective follow-up. *The Journal of Clinical Psychiatry* 68, 1411–1417.
- McHolm AE, MacMillan HL and Jamieson E (2003) The relationship between childhood physical abuse and suicidality among depressed women: results from a community sample. *American Journal of Psychiatry* 160, 933–938.
- Min JA, Lee SH, Lee SY, Chae JH, Lee CU, Park YM and Bae SM (2012) Clinical characteristics associated with different strengths of loudness dependence of auditory evoked potentials (LDAEP) in major depressive disorder. *Psychiatry Research* 200, 374–381.
- Mitchell PB, Frankland A, Hadzi-Pavlovic D, Roberts G, Corry J, Wright A, Loo CK and Breakspear M (2011) Comparison of depressive episodes in bipolar disorder and in major depressive disorder within bipolar disorder pedigrees. *British Journal of Psychiatry* 199, 303–309.
- Mugisha J, Muyinda H, Malamba S and Kinyanda E (2015) Major depressive disorder seven years after the conflict in northern Uganda: burden, risk factors and impact on outcomes (The Wayo-Nero Study). *BioMed Central Psychiatry* 15, 48.
- Nam YY, Kim CH and Roh D (2016) Comorbid panic disorder as an independent risk factor for suicide attempts in depressed outpatients. *Comprehensive Psychiatry* 67, 13–18.
- Nepon J, Belik SL, Bolton J and Sareen J (2010) The relationship between anxiety disorders and suicide attempts: findings from the national epidemiologic survey on alcohol and related conditions. *Depression and Anxiety* 27, 791–798.



- Nock MK, Borges G, Bromet EJ, Alonso J, Angermeyer M, Beautrais A, Bruffaerts R, Chiu WT, De Girolamo G and Gluzman S (2008) Cross-national prevalence and risk factors for suicidal ideation, plans and attempts. *British Journal of Psychiatry* **192**, 98–105.
- Nock MK, Hwang I, Sampson NA and Kessler RC (2010) Mental disorders, comorbidity and suicidal behavior: results from the national comorbidity survey replication. *Molecular Psychiatry* **15**, 868.
- Nordentoft M and Mortensen PB (2011) Absolute risk of suicide after first hospital contact in mental disorder. *Archives of General Psychiatry* **68**, 1058–1064.
- O'Donovan A, Rush G, Hoatam G, Hughes BM, McCrohan A, Kelleher C, O'Farrelly C and Malone KM (2013) Suicidal ideation is associated with elevated inflammation in patients with major depressive disorder. *Depression and Anxiety* **30**, 307–314.
- Oedegaard KJ, Neckelmann D, Benazzi F, Syrstad VE, Akiskal HS and Fasmer OB (2008) Dissociative experiences differentiate bipolar-II from unipolar depressed patients: the mediating role of cyclothymia and the Type A behaviour speed and impatience subscale. *Journal of Affective Disorders* **108**, 207–216.
- Oquendo MA, Galfalvy H, Russo S, Ellis SP, Grunebaum MF, Burke A and Mann JJ (2004) Prospective study of clinical predictors of suicidal acts after a major depressive episode in patients with major depressive disorder or bipolar disorder. *American Journal of Psychiatry* **161**, 1433–1441.
- Osváth P, Kelemen G, Erdős MB, Vörös V and Fekete S (2003) The main factors of repetition: review of some results of the Pecs Center in the WHO/EURO multicentre study on suicidal behaviour. *Crisis: Journal of Crisis Intervention and Suicide Prevention* **24**, 151.
- Ozer U, Yildirim EA and Erkoc SN (2015) Relationship of suicidal ideation and behavior to attachment style in patients with major depression. *Noro Psikiyatri Arsivi* **52**, 283–288.
- Park YM, Ko YH, Lee MS, Lee HJ and Kim L (2014) Type-d personality can predict suicidality in patients with major depressive disorder. *Psychiatry Investigation* **11**, 232–236.
- Park EH, Hong N, Jon DI, Hong HJ and Jung MH (2017) Past suicidal ideation as an independent risk factor for suicide behaviours in patients with depression. *International Journal of Psychiatry in Clinical Practice* **21**, 24–28.
- Pawlak J, Dmitrzak-Weglarz M, Wilkosc M, Szczepankiewicz A, Leszczynska-Rodziewicz A, Zaremba D, Kapelski P, Rajewska-Rager A and Hauser J (2016) Suicide behavior as a quantitative trait and its genetic background. *Journal of Affective Disorders* **206**, 241–250.
- Peng HJ, Wu K, Li J, Qi HC, Guo SW, Chi MY, Wu XM, Guo YB, Yang YL and Ning YP (2014) Increased suicide attempts in young depressed patients with abnormal temporal-parietal-limbic gray matter volume. *Journal of Affective Disorders* **165**, 69–73.
- Phillips MR, Yang G, Zhang Y, Wang L, Ji H and Zhou M (2002) Risk factors for suicide in China: a national case-control psychological autopsy study. *Lancet* **360**, 1728–1736.
- Pompili M, Gibiino S, Innamorati M, Serafini G, Del Casale A, De Risio L, Palermo M, Montebovi F, Campi S, De Luca V, Sher L, Tatarelli R, Biondi M, Duval F, Serretti A and Girardi P (2012) Prolactin and thyroid hormone levels are associated with suicide attempts in psychiatric patients. *Psychiatry Research* **200**, 389–394.
- Posner K, Oquendo MA, Gould M, Stanley B and Davies M (2007) Columbia classification Algorithm of Suicide Assessment (C-CASA): classification of suicidal events in the FDA's pediatric suicidal risk analysis of antidepressants. *American Journal of Psychiatry* **164**, 1035–1043.
- Rihmer Z and Kiss K (2002) Bipolar disorders and suicidal behaviour. *Bipolar Disorders* **4**, 21–25.
- Riihimäki K, Vuorilehto M, Melartin T, Haukka J and Isometsä E (2014) Incidence and predictors of suicide attempts among primary-care patients with depressive disorders: a 5-year prospective study. *Psychological Medicine* **44**, 291–302.
- Seo HJ, Jung YE, Jeong S, Kim JB, Lee MS, Kim JM, Yim HW and Jun TY (2014) Personality traits associated with suicidal behaviors in patients with depression: the CRESCEND study. *Comprehensive Psychiatry* **55**, 1085–1092.
- Serafini G, Pompili M, Innamorati M, Fusar-Poli P, Akiskal HS, Rihmer Z, Lester D, Romano A, de Oliveira IR, Strusi L, Ferracuti S, Girardi P and Tatarelli R (2011) Affective temperamental profiles are associated with white matter hyperintensity and suicidal risk in patients with mood disorders. *Journal of Affective Disorders* **129**, 47–55.
- Sher L (2006) Risk and protective factors for suicide in patients with alcoholism. *The Scientific World Journal* **6**, 1405–1411.
- Sher L, Mann JJ, Traskman-Bendz L, Winchel R, Huang YY, Fertuck E and Stanley BH (2006) Lower cerebrospinal fluid homovanillic acid levels in depressed suicide attempters. *Journal of Affective Disorders* **90**, 83–89.
- Shibre T, Hanlon C, Medhin G, Alem A, Kebede D, Teferra S, Kullgren G, Jacobsson L and Fekadu A (2014) Suicide and suicide attempts in people with severe mental disorders in Butajira, Ethiopia: 10 year follow-up of a population-based cohort. *BioMed Central Psychiatry* **14**, 150.
- Sokero TP, Melartin TK, Rytsala HJ, Leskela US, Lestela-Mielonen PS and Isometsä ET (2005) Prospective study of risk factors for attempted suicide among patients with DSM-IV major depressive disorder. *British Journal of Psychiatry* **186**, 314–318.
- Souery D, Oswald P, Massat I, Bailer U, Bollen J, Demyttenaere K, Kasper S, Lecrubier Y, Montgomery S and Serretti A (2007) Clinical factors associated with treatment resistance in major depressive disorder: results from a European multicenter study. *Journal of Clinical Psychiatry* **68**, 1062–1070.
- Spalletta G, Troisi A, Saracco M, Ciani N and Pasini A (1996) Symptom profile, Axis II comorbidity and suicidal behaviour in young males with DSM-II-R depressive illnesses. *Journal of Affective Disorders* **39**, 141–148.
- Spitzer RL, Endicott J and Robins E (1978) Research diagnostic criteria: rationale and reliability. *Archives of General Psychiatry* **35**, 773–782.
- Stroup DF, Berlin JA, Morton SC, Olkin I, Williamson GD, Rennie D, Moher D, Becker BJ, Sipe TA and Thacker SB (2000) Meta-analysis of observational studies in epidemiology: a proposal for reporting. *Journal of American Medical Association* **283**, 2008–2012.
- Su MH, Chen HC, Lu ML, Feng J, Chen IM, Wu CS, Chang SW and Kuo PH (2018) Risk profiles of personality traits for suicidality among mood disorder patients and community controls. *Acta Psychiatrica Scandinavica* **137**, 30–38.
- Sublette ME, Galfalvy HC, Fuchs D, Lapidus M, Grunebaum MF, Oquendo MA, Mann JJ and Postolache TT (2011) Plasma kynurenine levels are elevated in suicide attempters with major depressive disorder. *Brain, Behavior, and Immunity* **25**, 1272–1278.
- Subramaniam M, Abdin E, Seow EL, Picco L, Vaingankar JA and Chong SA (2014) Suicidal ideation, suicidal plan and suicidal attempts among those with major depressive disorder. *Annals of the Academy of Medicine, Singapore* **43**, 412–421.
- Sudol K and Mann JJ (2017) Biomarkers of suicide attempt behavior: towards a biological model of risk. *Current Psychiatry Reports* **19**, 31.
- Suominen K, Isometsä E, Suokas J, Haukka J, Achte K and Lönnqvist J (2004) Completed suicide after a suicide attempt: a 37-year follow-up study. *American Journal of Psychiatry* **161**, 562–563.
- Tsuji N, Akashi H, Mikawa W, Tsujimoto E, Niwa A, Adachi T and Shirakawa O (2014) Discrepancy between self- and observer-rated depression severities as a predictor of vulnerability to suicide in patients with mild depression. *Journal of Affective Disorders* **161**, 144–149.
- van Noorden MS, Minkenberg SE, Giltay EJ, den Hollander-Gijsman ME, van Rood YR, van der Wee NJ and Zitman FG (2011) Pre-adult versus adult onset major depressive disorder in a naturalistic patient sample: the Leiden Routine Outcome Monitoring Study. *Psychological Medicine* **41**, 1407–1417.
- Vickers K and McNally RJ (2004) Panic disorder and suicide attempt in the National Comorbidity Survey. *Journal of Abnormal Psychology* **113**, 582.
- Vijayakumar L (2004) Suicide prevention: the urgent need in developing countries. *World Psychiatry* **3**, 158–159.
- Von Elm E, Altman DG, Egger M, Pocock SJ, Göttsche PC, Vandenbroucke JP and Initiative S (2007) The Strengthening of Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *PLoS Medicine* **4**, e296.
- Wakefield JC and Schmitz MF (2016) Feelings of worthlessness during a single complicated major depressive episode predict postremission suicide attempt. *Acta Psychiatrica Scandinavica* **133**, 257–265.
- Wan Y, Hu Q, Li T, Jiang L, Du Y, Feng L, Wong JC-M and Li C (2013) Prevalence of autism spectrum disorders among children in China: a systematic review. *Shanghai Archives of Psychiatry* **25**, 70.



- Wang S, Zhang K, Xu Y, Sun N, Shen Y and Xu Q (2009) An association study of the serotonin transporter and receptor genes with the suicidal ideation of major depression in a Chinese Han population. *Psychiatry Research* **170**, 204–207.
- Wei SN, Li HY, Hou JL, Chen W, Chen X and Qin XX (2017) Comparison of the characteristics of suicide attempters with major depressive disorder and those with no psychiatric diagnosis in emergency departments of general hospitals in China. *Annals of General Psychiatry* **16**, 44.
- WHO (2015) Suicide data. Available at [http://www.who.int/mental\\_health/prevention/suicide/suicideprevent/en/](http://www.who.int/mental_health/prevention/suicide/suicideprevent/en/).
- Winsper C, Ganapathy R, Marwaha S, Large M, Birchwood M and Singh S (2013) A systematic review and meta-regression analysis of aggression during the First Episode of Psychosis. *Acta Psychiatrica Scandinavica* **128**, 413–421.
- Witte TK, Timmons KA, Fink E, Smith AR and Joiner TE (2009) Do major depressive disorder and dysthymic disorder confer differential risk for suicide? *Journal of Affective Disorders* **115**, 69–78.
- Worldbank (2017) New country classifications by income level: 2017–2018. Available at [databank.worldbank.org/data/download/site-content/CLASS.xls](http://databank.worldbank.org/data/download/site-content/CLASS.xls).
- Yeh YW, Ho PS, Chen CY, Kuo SC, Liang CS, Ma KH, Shiue CY, Huang WS, Cheng CY, Wang TY, Lu RB and Huang SY (2015) Incongruent reduction of serotonin transporter associated with suicide attempts in patients with major depressive disorder: a positron emission tomography study with 4-[F-18]-ADAM. *International Journal of Neuropsychopharmacology* **18**, 1–9.
- Yenilmez E, Kumsar NA, Kütük EK and Dilbaz N (2014) Comparison between clinical features and residual depressive symptoms of patients with bipolar depressive and unipolar depressive disorder in remission. *African Journal of Psychiatry (South Africa)* **17**, 119.
- Yoshimasu K, Kiyohara C and Miyashita K (2008) Suicidal risk factors and completed suicide: meta-analyses based on psychological autopsy studies. *Environmental health and preventive medicine* **13**, 243.
- Zayas L, Gulbas LE, Fedoravicius N and Cabassa LJ (2010) Patterns of distress, precipitating events, and reflections on suicide attempts by young Latinas. *Social Science and Medicine* **70**, 1773–1779.
- Zeng R, Cohen LJ, Tanis T, Qizilbash A, Lopatyuk Y, Yaseen ZS and Galynker I (2015) Assessing the contribution of borderline personality disorder and features to suicide risk in psychiatric inpatients with bipolar disorder, major depression and schizoaffective disorder. *Psychiatry Research* **226**, 361–367.
- Zhu Y, Zhang H, Shi S, Gao J, Li Y, Tao M, Zhang K, Wang X, Gao C, Yang L, Li K, Shi J, Wang G, Liu L, Zhang J, Du B, Jiang G, Shen J, Zhang Z, Liang W, Sun J, Hu J, Liu T, Wang X, Miao G, Meng H, Li Y, Hu C, Li Y, Huang G, Li G, Ha B, Deng H, Mei Q, Zhong H, Gao S, Sang H, Zhang Y, Fang X, Yu F, Yang D, Liu T, Chen Y, Hong X, Wu W, Chen G, Cai M, Song Y, Pan J, Dong J, Pan R, Zhang W, Shen Z, Liu Z, Gu D, Wang X, Liu X, Zhang Q, Li Y, Chen Y, Kendler KS, Flint J and Liu Y (2013) Suicidal risk factors of recurrent major depression in Han Chinese women. *PLoS One* **8**, e80030.
- Zisook S, Goff A, Sledge P and Shuchter SR (1994) Reported suicidal behavior and current suicidal ideation in a psychiatric outpatient clinic. *Annals of Clinical Psychiatry* **6**, 27–31.
- Zlotnick C, Mattia J and Zimmerman M (2001) Clinical features of survivors of sexual abuse with major depression. *Child Abuse and Neglect* **25**, 357–367.